Robots descend on the NBL

by Kelly Humphries and Kimberly Harle

Overcoming underwater was the name of the game at JSC's Neutral Buoyancy Laboratory (NBL) the third weekend in June as some 400 students from across North America competed in the fourth annual national finals for student-built underwater remotely operated vehicles (ROVs).

Forty-two student teams designed, built and operated the underwater robots that competed June 17–19 at the Sonny Carter Training Facility. The event, organized by the Marine Advanced Technology Education (MATE) Center and the Marine Technology Society, is designed to help students develop technical, problem-solving and teamwork skills that will help them in future careers in ocean and space science, engineering and exploration.

Every year, the competition challenges students to develop undersea and space ROV technology that can move, grapple, carry, retrieve, install, sample and measure. ROVs come in two classes and all shapes and sizes. They are made of PVC, chicken wire, kitchen tongs and foam pool "noodles" for buoyancy. Controlled and powered by tethers, they are guided by topside student pilots using only video images from the ROVs to "fly" the vehicle and perform tasks.

"The goal this year is to help you see how technology developments in ocean work can be used in space and vice versa, to help you see how similar these two environments are," Jill Zande, MATE competition coordinator, told students at the competition's June 17 kick-off ceremony held at Space Center Houston.

"You came to compete, and many of you have your eye set on first place," Adena Loston, NASA chief education officer, told the competitors. "None of that matters to NASA. I'm here because all of you are winners to us. It's competitions like these that we hope will inspire you to pursue careers in math, science, technology and engineering."

The scenario faced by the larger explorer-class robots this year involved a mission to the waters that lie beneath the Jupiter moon Europa's ice-crusted surface. The robots had to descend through a simulated ice hole to repair a communications link with a science package, retrieve data probes, take a fluid sample and measure the temperature of an underwater vent.

Explorer team robots competed on the floor of the NBL, a full 40 feet below the surface. First place went to the Eastern Edge Robotics Team, Mt. Pearl, Newfoundland, Canada. Second place went to Monterey Peninsula College, Calif., and third place went to Carl Hayden High School, Phoenix, Ariz.

The smaller "Ranger" teams had to cap an old oil well, repair a damaged subsea telecommunications cable and install a new instrument on the Hubble Space Telescope while submerged on a platform 15 feet below the surface. High Technology High School, Lincroft, N.J., won. Second and third places went to two Texas teams from the Career and Technology Education Center, Humble, and Pasadena Memorial High School.

"It was a great experience," said Michael MacIntyre of the University of San Diego High School in California. "We learned a lot about teamwork and cooperation among other practical and valuable skills, like soldering."

"It's definitely worth the work and long hours," said Sayre Jeannet of the Alaska Polar Submersible Team. "It really teaches you how to work with other people and how to meet deadlines. It was a great way to apply what you learn in class."

The students also took part in an interactive event with "aquanauts" 60 feet underwater inside National Oceanic and Atmospheric Administration's (NOAA's) Aquarius underwater habitat off Key Largo, Fla. Astronaut Clay Anderson, who lived aboard Aquarius as part of the NASA Extreme Environment Mission Operations Project, was at the ceremony to explain how the only underwater laboratory in the world is being used to train astronauts preparing for long-duration space missions.

opportunity for those of us who work at the NBL to showcase our facility, especially to a group of kids who have the potential to be our coworkers in a few years."

For more information about the MATE Center or the competition, visit: **http://www.marinetech.org**

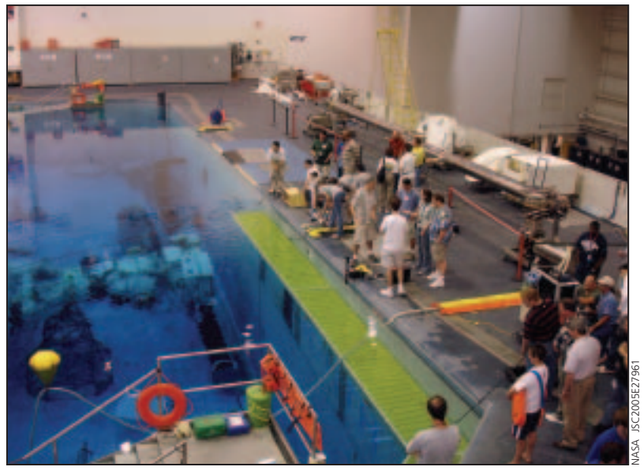
NASA JSC2005E27960

Before the students arrived, their rovers had been shipped to the NBL's light manufacturing facility (LMF). After a test run, the students were able to make last minute modifications to the underwater robots in the LMF.

"Every element of the competition worked very well," said Lisa Spence, an NBL flight lead for the Mission Operations Directorate, who planned and coordinated the event with MATE and other JSC organizations. "I saw a lot of interaction between the volunteers, a lot of information-sharing with the students and very good comments on how friendly, helpful and professional all of our folks were."

Almost four dozen volunteers from JSC, all dressed in bright yellow NBL T-shirts, helped keep things running smoothly. Spence said JSC plans to host next year's regional competition, and that MATE is seriously considering asking the NBL to host next year's finals. The competition is supported by funds, equipment and facilities donated by the National Science Foundation and NOAA's Office of Ocean Exploration and several space and oceanic exploration companies.

"It's just a ton of fun to see the creativity and energy that these kids have," said Spence, who organized the past three Texas Regional competitions. "It's a great



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The Explorer class, which consisted of high school and college students, competed on the very bottom of the NBL's pool – 40 feet deep. Their scenario involved restoring communications with an instrument package and retrieving samples from the waters that lie beneath the Jupiter moon Europa's ice-crusted surface.

Setting the date

Teams work to select Shuttle launch windows

by Kendra Phipps

Wedding planners have got nothing on JSC's Flight Design and Dynamics Division.

Sure, it's hard to coordinate caterers, florists and musicians, but that's nothing compared to the task of flight designers and flight dynamics officers – literally making sure that the heavens are aligned for a Space Shuttle launch. It is their job to ensure that a launch window has the right combination of factors such as orbits, inclinations, planetary rotation and sunlight.

This is not a job for someone who slept through physics class.

"A Flight Dynamics Officer is responsible for all things related to Shuttle trajectory – where it is and where it's going," said Bill Tracy with United Space Alliance (USA). Tracy is the lead Flight Dynamics Officer (FDO) for STS-114. The job includes narrowing down the possible times that a Shuttle could launch.

Narrowing it down

The initial launch date selection process is up to NASA Headquarters and the Shuttle and International Space Station Programs, said Steve Staas, STS-114 Flight Design Manager with USA. After that, FDOs at JSC help in the final selection by looking at factors such as lighting and the "in-plane time."

NASA 01PP1468

In-plane time refers to the point when the plane of the International Space Station's orbit is over the Kennedy Space Center (KSC) launch site. Launches must occur within five minutes of the in-plane time to assure a rendezvous with the Station.

Tracy said that "we can launch any day of the year" because the in-plane time occurs twice every day.

However, only one window per day is usable due to the inclination, or angle, of the Station's orbit. The ascent trajectory must be headed from south to north for a Shuttle launch. If the Shuttle were to launch while the Station was headed south, the orbiter could not safely discard its External Tank into the ocean, nor could it reach its abort landing sites if needed.

Along with in-plane time and inclination, lighting must be factored in.

Good lighting is crucial for observations of the Shuttle's External Tank during launch and ascent; experts on the ground need to keep tabs on the recent adjustments made to reduce foam debris. Many cameras, including the orbiter's umbilical camera and the crew's handheld cameras, will be scrutinizing the tank. With that in mind, FDOs look for launch opportunities that will provide ample sunlight for a clear view.

But even the best planning can't guarantee a sunny day. And unlike a wedding, rain isn't considered good luck for a launch. That's where Frank Brody and his team come in.

What about the weather?

Brody is the Chief of the National Weather Service Spaceflight Meteorology Group (SMG) at JSC. One of the group's roles is to examine weather and climatology for launches and landings.

"Climatology is what you expect; weather is what you get," Brody said.

He said that, during the 80s and much of the 90s, when most missions weren't docking with a space station, climatology was a "prime factor" in selecting a launch window. Without the restriction of in-plane time to meet rendezvous requirements, experts were free to set a launch window during a summer morning if the mission's science objectives allowed, knowing that thunderstorms are less likely in Florida at that time of day.

Once rendezvous missions became the norm, however, and launch windows shrank to five or 10 minutes per day, climatology could not play as large a role in window selection. But weather – the actual, real-time conditions at launch and landing sites – is still vitally important.

When it comes to evaluating launch day weather, Brody said that there are two sets of rules involved. One set is called the Launch Commit Criteria (LCC), monitored by weather experts, Air Force officials and launch controllers at KSC. The other set, the flight rules for an abort landing, are watched by SMG and JSC flight controllers to make sure that, if the Shuttle had to make an emergency landing, the conditions would be safe to do so. This involves watching weather conditions not only at KSC, but also at possible landing sites in New Mexico, California, Spain and France.

"Basically, you can't launch unless you can land," Brody said. For each possible landing site, his team monitors conditions such as cloud ceiling height, visibility, cross-wind speed and location of nearby thunderstorms.

"This is not a job for someone who slept through physics class."

It is possible that the LCC guidelines indicate a "go" for launch while the abort landing flight rules say "no go," and vice versa; but the decision to launch lies with the flight director, launch director and, ultimately, Deputy Shuttle Program Manager Wayne Hale, who chairs the Mission Management Team.

Even after in-plane time, orbit inclination, lighting and weather have been coordinated as well as possible, a launch could still be postponed due to a hardware problem or a number of other factors. In that case, the big event is bumped to the next available window. The process continues until the conditions are right and the launch is as safe as it can be.

All the effort is worth it when a Shuttle lifts off the pad, said Tracy.

"I have a front-row seat to the best show in the world," he said.